Laboratoire d'Annecy-le-Vieux
de Physique des Particules

Superconducting final doublet Support

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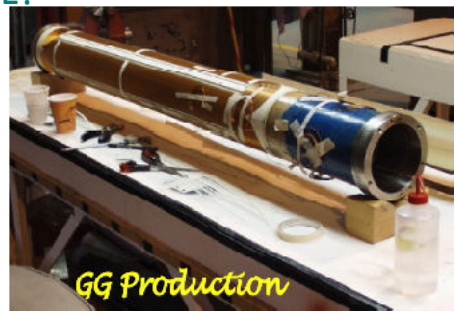
In2p3

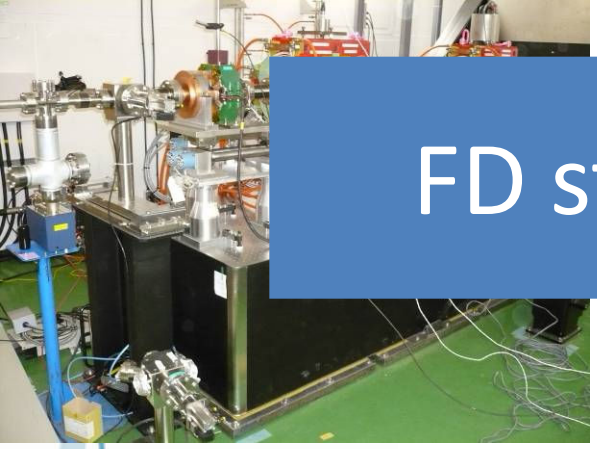
From 7th ATF2 project December 2008

SC magnet steps

- Motivation: have an active stabilisation as planned in ILC and CLIC => need to evaluate the usefulness of an active system at ATF2 /Benoit's work plan/soon at KEK LAPP/CERN/LAL/KEK
- Need a magnet:
  - Test it with cryogenics/
    - B.Parker/ BNL/ soon
  - Measure vibrations with seismic and laser interferometry of cold mass mouvmt.
    - LAPP/CERN / at BNL? When magnet ready/ Oxford (Urner) at BNL?
  - Identify vibration sources like GM, cryolines, acoustic
    - LAPP/CERN / at BNL? When magnet ready
- Design support:
  - With stabilisation/isolation LAPP/BNL
  - Cryoline isolation CERN
  - With compensation (multisensor/multicatuator vs single sensor/single actuator) LAPP/UDS
- How many FD magnets in same cryostat? LAL/CERN/LAPP…



Already achieved 0.13nm rms at 4Hz combining commercial isolation "x10"(CLIC table) and "single" compensation"x3" but in laboratory on a mock-up not in accelerator environment

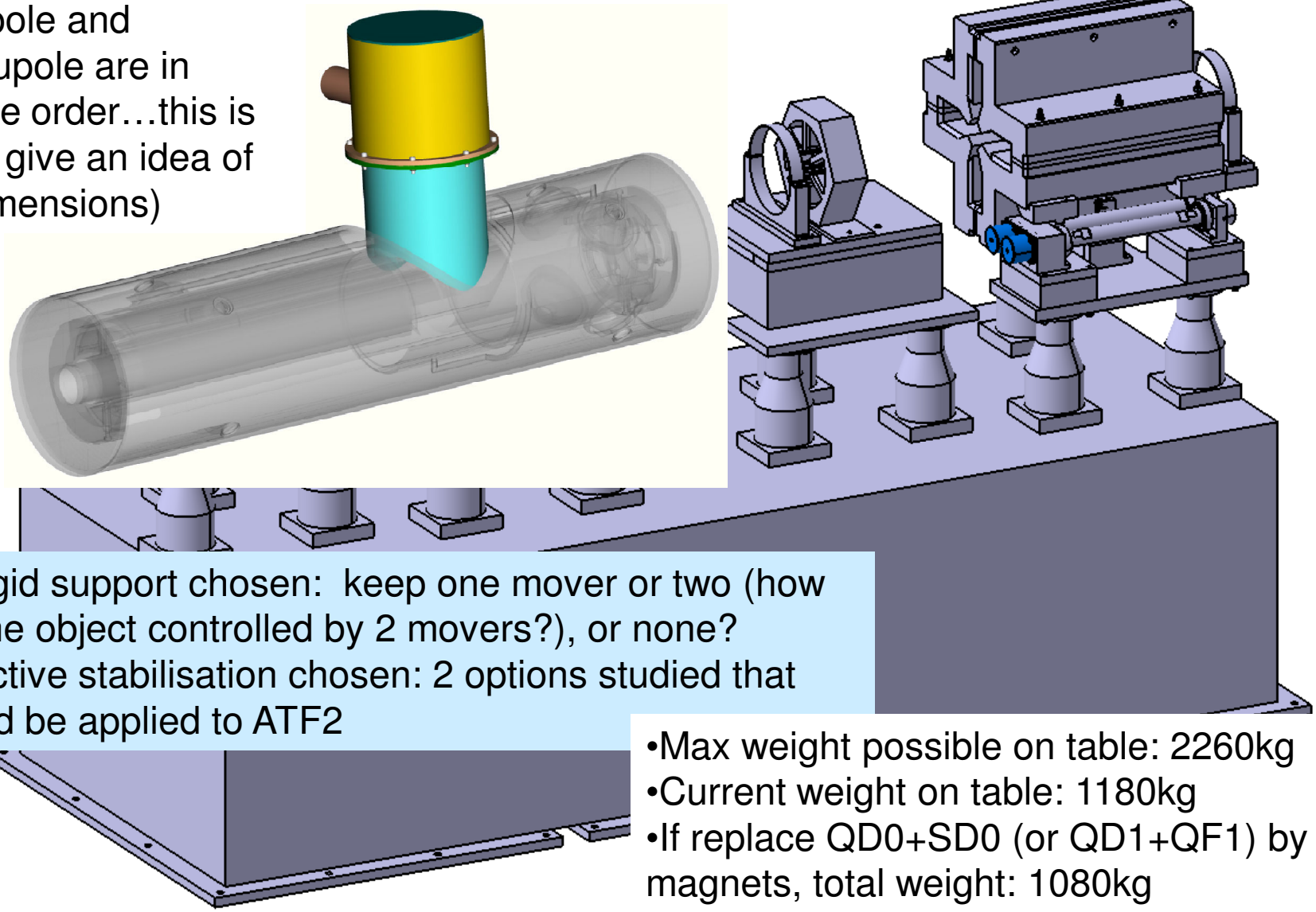


FD stabilisation with larger L*

- Technically FD support can be moved anywhere
- Current assumption: ground motion coherence length of 4m (Benoît will show new measurements at future ATF2 meeting), so QF1 and IP should not be separated by more than 4m
- If active stabilisation is implemented, then coherence is lost between IP and FD, so no more separation issue => Shintake monitor also on active stabilisation?

SC magnet support

(beware, here the sextupole and quadrupole are in reverse order…this is just to give an idea of the dimensions)



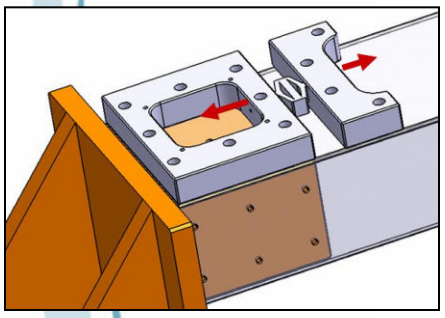
•If rigid support chosen: keep one mover or two (how is one object controlled by 2 movers?), or none?
•If active stabilisation chosen: 2 options studied that could be applied to ATF2

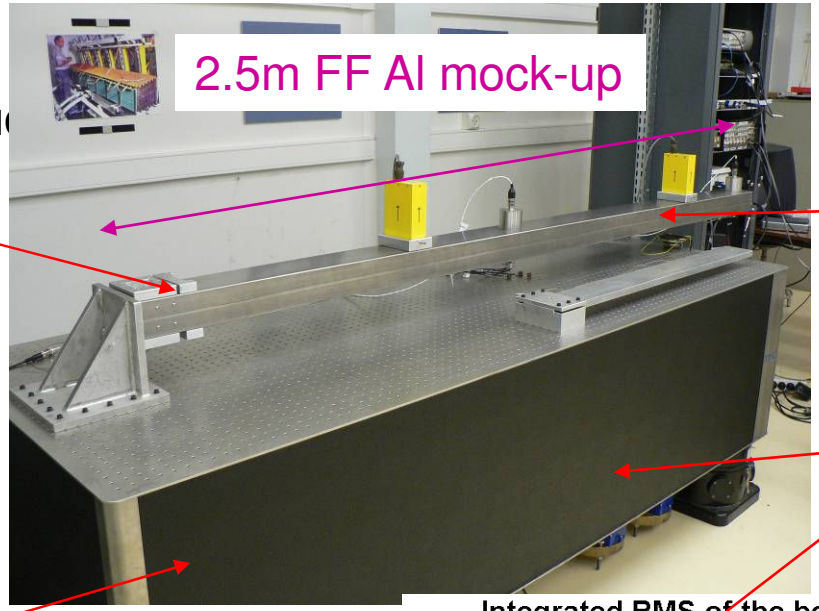
•Max weight possible on table: 2260kg
•Current weight on table: 1180kg
•If replace QD0+SD0 (or QD1+QF1) by SC magnets, total weight: 1080kg
•Cryogenic fluids:?
•Still free for Cryogenics system: 1180kg

Cantilever option

But some study needs to continue on appropriate sensors

LAPP active system for resonance rejection

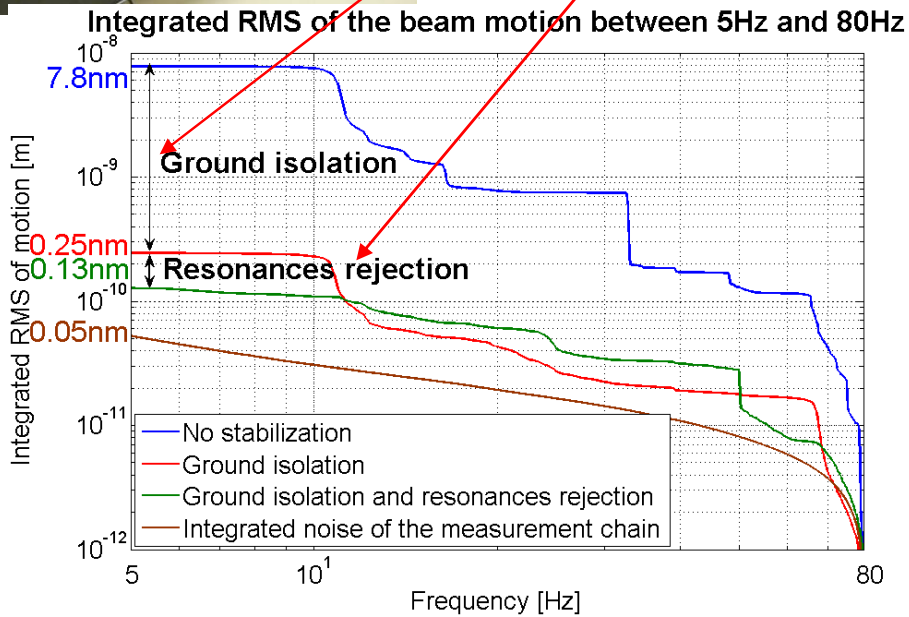




Resonance rejection

Isolation

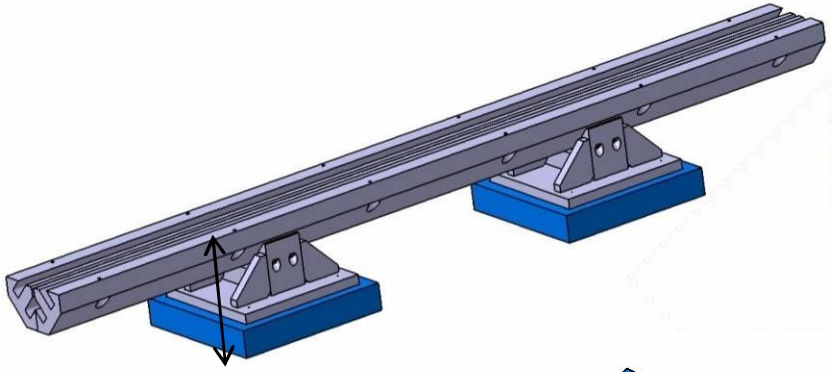
CERN TMC active table for isolation (active and passive layers in feet)

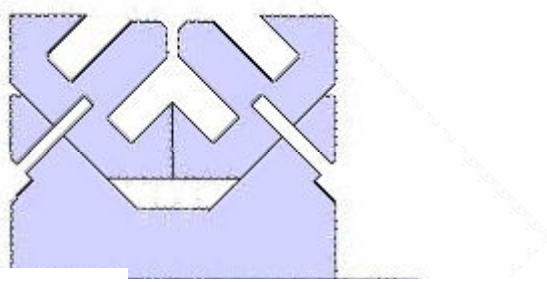


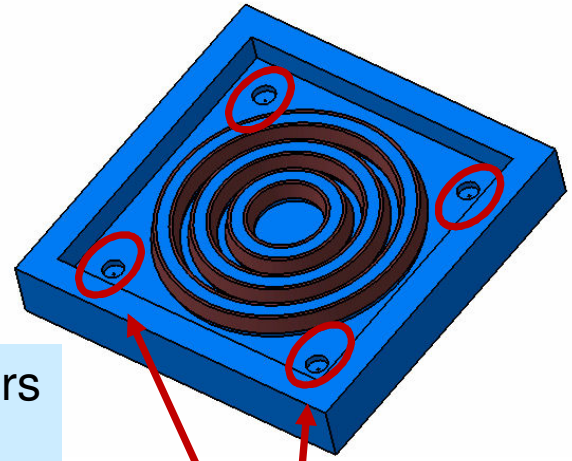
- **The two first resonances entirely rejected**
- **Achieved integrated rms of 0.13nm at 5Hz**

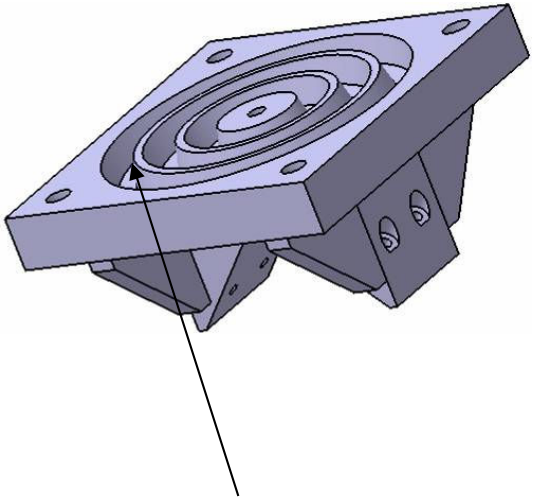
(L.Brunetti et al, 2007)

2 feet option
CLIC MB linac Q









Combine passive and active layers
Results expected in 2010-2011

Actuators positions

Elastomer in groove

Some comments and questions

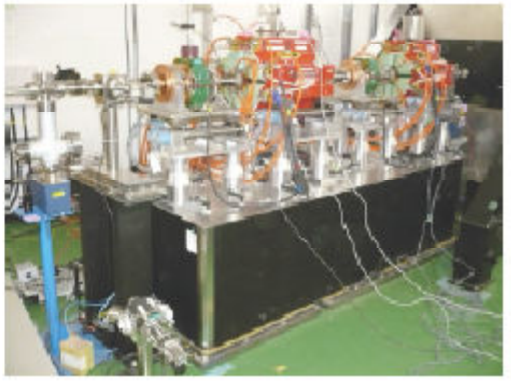
- GM generator updated for simulation (B.Bolzon 8th Project meeting); FF magnets do not need stabilisation
- Need vibration simulations of the SC-Q inside cryostat.
- Vibration measurements (before sending to KEK?) on SC-Q and cryostat to correlate simulations and measurements
- Are the stability requirements the same as for initial ATF2 : 6-7nm and because we add beam-based feedback (up to what frequency?), can we relax to 50nm?
- Does the 50nm come from a physical limit and we work in degraded mode?
- If temperature variations cause low-frequency vibrations, shouldn't they be compensated by beam-based feedback?
- => Need to understand the vibration requirements

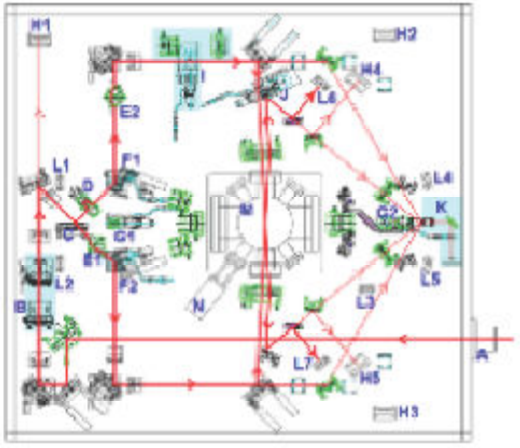
(2) Shintake-monitor

Measurement of 37μm beam size

-> Require a few nm beam stabilization

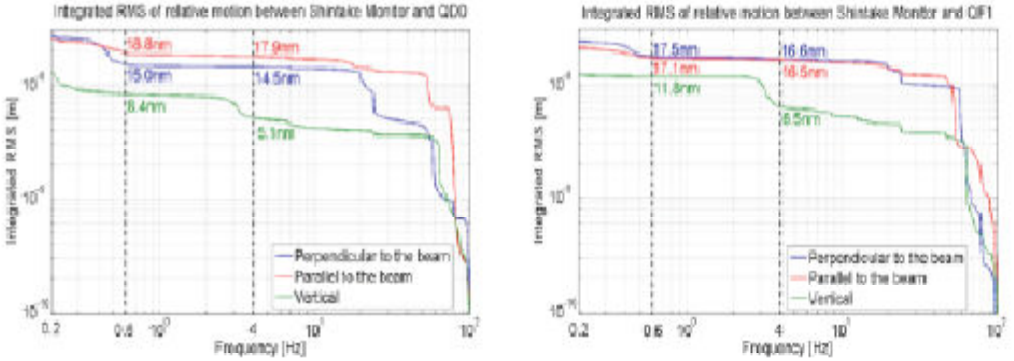
-> Introduction of beam feedback/feedforward mitigates beam stability of 50nm.





T. Yamanaka (2008)
T. Kume (2009)
B. Bolzon (2009)

Shintake monitor and ATF magnet are located on separated rigid-table.



Integrated RMS of relative motion between SM and QD0 (left) and between SM and QF1 (right)

Relative displacement between Magnet bench and Shintake monitor bench Is below 10nm at low frequency.

Tomaru-san “face to face” meeting 24/11/2009

Support requirements

- In order to have low relative displacement between FD and IP, we need to push the resonance peaks to higher frequency (if possible above 100Hz).
- Current support: rigid support => take advantage of the 4m coherence length and “rigid” vibration behaviour of the components=> fixed table 90Hz, mover+magnet 75Hz, very small (if any) influence of cooling water effect on vibrations.
- What is the first resonance peak of SC-Q and cryostat? Can we do something if it is very low? Cryomeasurements done by DESY show peaks between 10-30Hz from support and not from inside module.

EPAC2008 WEPMN009

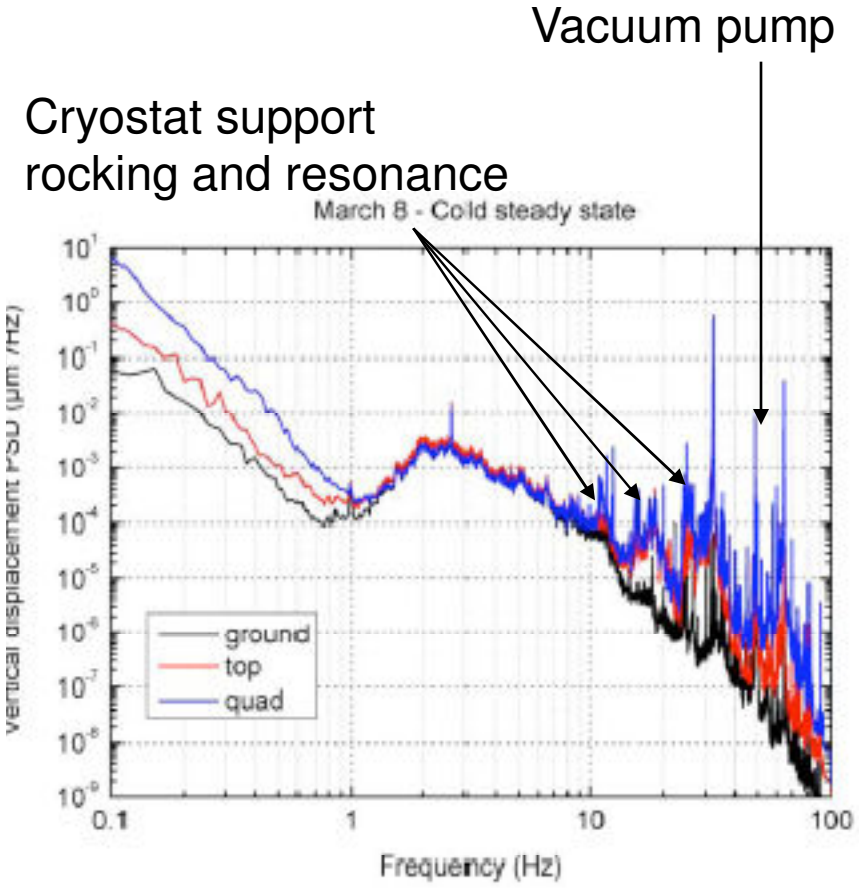


Figure 5: PSDs of ground, vessel top and quadrupole in cold steady state with RF off, measured just after reaching the cold stable conditions at the end of the 11th cooldown.

Does the support study need ATF2?

- Test SC-Q with cryogenics must be done outside ATF2 first but also at KEK with final cryogenics
- Simulations and vibration measurements can be done elsewhere => need this to decide for/against active stabilisation
- Identify vibration sources like GM, cryolines, acoustics need to be done in accelerator environment: ATF2
- If we keep rigid support, then ATF2 is good since it is already in place.
- If we need stabilisation, better elsewhere first in a quiet place.
- Later put in accelerator environment: ATF2.

Does the support study need ATF2?

Plan for 2010

- Test SC-Q with cryogenics must be done outside ATF2 first but also at KEK with final cryogenics
- Simulations and vibrations measurements can be done elsewhere by BNL=> need this to decide for/against active stabilisation
- Identify vibration sources like GM, cryolines, acoustics need to be done in accelerator environment: ATF2
- If we keep rigid support, then ATF2 is good since it is already in place.
- If we need stabilisation, better elsewhere first in a quiet place.
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